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Journal of Project Management

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Investigating the influence of sustainable and smart supply chain practices on the entrepreneurial ecosystem of startup projects

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A B S T R A C T

Article history:
Received October 3, 2024
Received in revised format December 26, 2024
Accepted March 17 2025
Available online March 17 2025

Keywords:
Startups
Entrepreneurial Ecosystem
Smart Supply Chain Practices
Sustainability
Digital Technologies
Startup Performance

In the era of the digital world, supply chain systems and processes have changed in an unprecedented manner. Digital technologies and AI related applications have impacted the way in which supply chains are operated compared to traditional and linear supply chains in the previous era. Supply chains in this era are able to be agile, resilient and smarter. Some of the drawbacks of linear supply chains are addressed in the modern supply chains with the application of digital technologies. The future of supply chains now lies in focusing on achieving sustainability by leveraging the advantages provided by the technologies. Sustainability has gained increased focus both in the academic discipline as well as among industry practitioners especially after the development of Sustainable Development Goals (SDGs) by the United Nations. However, most of this development is limited to large scale enterprises and there is a need to improve it in Small and Medium Enterprises (SMEs) and Startups. In Particular, startups require a lot of support in developing their ecosystem in the initial days of their existence. Two major practices of supply chain are found to impact the entrepreneurial ecosystem of startups. The first one is smart supply chain related practices and the second one is sustainable supply chain related practices. This article focuses on the influence of these practices on the entrepreneurial ecosystem of startups. Both these supply chain practices are found to positively influence the development of the entrepreneurial ecosystem. An empirical survey was conducted using a structured questionnaire as a survey instrument in 85 pharmaceutical companies in India. The director of SMEs of Telangana state government was used to qualify the startups and SMEs based on different criteria. A total of 220 responses were received from these companies. Convenient cluster sampling technique was used to select the sample size. The responses were analysed using regression and ANOVA through SPSS. It is found that the smart and sustainable supply chain practices can foster the development of the entrepreneurial ecosystem of startups. The outcomes of this study provide high value-addition to researchers, academicians, students, policy makers, budding entrepreneurs and startup owners and employees.

1. Introduction

There has been an unprecedented increase in the interest among researchers related to research-oriented empirical investigations in the area of supply chain management and its impact on improvement of performance of startups and entrepreneurial ventures. Practices related to Supply Chain Management (SCM) have gained a lot of importance among aspiring entrepreneurs and existing entrepreneurs to scale up their ventures and to achieve sustainability. Affordable and open-source digital and smart technologies have been playing a major role in managing supply chains of these startups (Lia et al., 2025). With the implementation of these technologies, startups are able to identify and track their inventory easily and effectively. At the same time, supply chain coordination, collaboration, and supply-demand balance have improved with the application of digital technologies (Alshurideh et al., 2023). Role of these technologies is also found to enable an encouraging

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ISSN 2371-8374 (Online) - ISSN 2371-8366 (Print)

doi: 10.5267/j.jpm.2025.3.006

entrepreneurial ecosystem in many countries in the world and also improved the performance of startups in gaining competitive advantage. Entrepreneurs have been able to achieve increased performance in some of the supply chain metrics such as inventory turnover ratio, customer satisfaction, availability of product, costs related to SC operations, reduction in bullwhip effect and enhancement of brand perception and scalability.

It is also found that SC practices such as lean management and effective inventory management through just-in-time techniques have the ability to minimize waste resulting in cost reduction and enabling the startups to provide resources for productive activities such as creativity and innovation in their business operations. Digital technologies such as cloud computing provide entrepreneurs to track inventory on a real time basis enabling the ability to take correct and effective decisions by synchronizing with the market dynamics. Startups are also found to improve their capabilities towards achieving resilience and achieve sustainability by recovering very fast from unexpected disruptions (Amedofu et al., 2019; Singh et al., 2023; Lia et al., 2025).

SC practices such as collaboration and mutual coordination with strategic partners such as suppliers, dealers, distributors, wholesalers and retailers enable startups with adequate resources, entering into supply contracts, better inventory management, improvement in quality of product, product availability and reduced lead times and on time deliveries. These outcomes enhance the brand reputation and result in enhanced customer satisfaction and confidence (Lee & Peterson, 2023). Startups also gain the ability to develop effective risk mitigation strategies along with a plan to manage risks in a better manner providing the capacity to face disruptions (Zhang & Zhao, 2023). Wijaya (2023) found that the implementation of SCM can lead to increased competitive advantage and improve organizational performance for development of a robust entrepreneurial ecosystem.

Entrepreneurial ecosystem is a combination of diverse set of groups, elements, and individuals which enables and encourages prospective entrepreneurs, individuals, owners of small enterprises and startups to manage their business operations in a sustainable manner. This ecosystem also encourages entrepreneurs with favourable and flexible systems, processes, policies and approvals. This ecosystem is a network of interdependent institutional elements involved in formation, expansion and growth of new entrepreneurial organizations. Supporting the availability of resources, required knowledge to manage the ventures, providing training and development to budding entrepreneurs and owners of startups are major objectives of the entrepreneurial ecosystem in different regions of the world (Stam & van de Ven, 2019; Alvedalen & Boschma, 2021). Individuals with prospective entrepreneurial intentions look for financial support, infrastructural resources, guidance in developing strategies, plan for managing initial risks and uncertainties and for promoting their ventures through the interconnected system of entrepreneurial ecosystem. Basically, the objective of any entrepreneurial ecosystem is to provide a conducive system and environment to promote entrepreneurship. Most of the entrepreneurs face problems related to establishment of their supply chain networks and managing them further to scale up their ventures. An entrepreneurial ecosystem also supports entrepreneurs by providing them with required supply chain knowledge to manage effectively. These systems are supposed to be flexible, dynamic and get updated based on the prevailing business environment and startup environment in a particular region (Audretsch & Link, 2022). Changing market conditions, dynamic policies and procedures of the regulatory environment, supportive policies by government and other institutions and developing an encouraging entrepreneurial culture are primary responsibilities of an entrepreneurial ecosystem. Role of government policies in shaping up an entrepreneurial ecosystem is very important in promoting entrepreneurship and for sustainability and scalability startups particularly in areas where such a system is less developed (Brown & Mawson, 2022). Emerging and affordable digital technologies are also part of this ecosystem, enabling entrepreneurs to move towards achieving sustainability and scaling up for expansion towards large organizations. In the recent past, there has been a greater emphasis on research related to the study of factors responsible for building a dynamic and supportive entrepreneurial ecosystem (Spigel &d Harrison, 2021; Wijayaa, 2023; Lia et al., 2025). Many studies reveal that an effective entrepreneurial ecosystem can be developed if the focus of entrepreneurs and elements of the ecosystem is on developing and implementing effective supply chain practices in the initial days of commencement of their ventures. Smart and sustainable supply chain practices are found to be two major SC practices out of many other practices to lead startups towards their success by building a favourable entrepreneurial ecosystem (Lelo & Israel, 2024). These practices are also found to promote inclusive and diverse ecosystems leading to the growth of ventures and startups from all sectors, making them robust, strong, resilient and sustainable. This is also found to promote creativity and innovation among the startups (Malecki & Spigel, 2021).

A well-established and developed infrastructure is a pre-requisite for enabling supply chain systems and processes in startups to achieve resilience, agility and flexibility leading to the development of the ecosystem. This kind of infrastructure will provide minimal damage to supply chains of startups during disruptions and risks and it will make them recover quickly to normalcy by taking measures to manage the disrupted supply chain environment. During disruptions, supply chain coordination and information sharing are utmost important to maintain robust supply chain infrastructure. Smart and sustainable supply chains through digital technologies and public-private partnerships (PPPs) will enable this kind of supply chain ecosystem and infrastructure (Wang & Ranjan, 2020; Manfredi & Capik, 2022). Technologies such as blockchain, artificial intelligence, and robotics are found to develop smart supply chain infrastructure enabling sustainability in the entrepreneurial ecosystem (Rahman et al., 2022; Amin, 2023).

Among many other popular supply chain practices, smart and sustainable supply chain practices have been found to be influencing the development of entrepreneurial ecosystems of startups. The focus on these two practices has increased in the research community supported by the practices led by the industries (Amedofu et al., 2019; Lelo & Israel, 2024).). Implementation of these practices is already popular globally and in India among the large scale pharmaceutical enterprises which have their inherent advantages in terms of investment and expertise. But, at the same, pharmaceutical companies belonging to the small and medium sector in India face many hurdles in the implementation of these practices. Insufficient awareness, lack of interest and expertise, financial constraints, limited innovation, lack of technological capabilities, supply chain complexity in a startup, compliance to regulatory issues, and misconceptions regarding the benefits of SCM implementation (Parmar, V., 2021), prioritising the issue of survival of startup rather than understanding and adopting SCM practices (Setyaningsih & Kelle, 2022), level of awareness among top management regarding SCM strategies and practices (Ramakrishna et al., 2023; Nasseri & Singh, 2024). Research contributions in this area are found to be less. Therefore, there is a need to investigate the status of implementation of these practices in startups and SMEs in pharmaceutical enterprises to explore the effect of them on the entrepreneurial ecosystem of startups. The present study aims to identify practices in smart and sustainable supply chain management and investigate their influence on entrepreneurial ecosystems of startups and SMEs through an empirical study.

In India, the focus on promoting and developing the entrepreneurial ecosystem has gained high importance with the emergence of digital technologies. Startups and SMEs got a great opportunity to scale up by promoting their products and services in a global market with the application of IT and digital technologies (Sharma & Kumar, 2025). However, there is a need to support these Startups and SMEs further in terms of building and developing their robust supply chain systems for sustainability, which would develop the entrepreneurial ecosystem of startups. By focusing on smart and sustainable supply chain practices, SMEs and startups can transform their traditional and linear supply chains to robust and smart supply chains. SMEs and startups can gain competitive advantage by integrating and applying digital technologies such as Artificial Intelligence (AI), Robotics, Machine Learning, Cloud Computing and Big Data Analytics (BDA). These technologies have the ability to promote the overall entrepreneurial ecosystem by building a smart supply chain system for startups (Wijayaa, 2023; Lia et al., 2025). Supply chain objectives such as product availability, assortment, reduction of lead-time and effective inventory management can be achieved in startups through smart supply chain systems. Developing a supply chain network for startups will enable information sharing, mutual coordination, cost optimization and enhanced opportunity for scaling up and improving the organizational performance, leading to development of an entrepreneurial ecosystem for startups through supply chain (Lelo & Israel, 2024).

2. Literature review

The objective of this research is to investigate empirically the relationship and influence of smart and sustainable supply chain practices on the development of entrepreneurial ecosystems. To identify the ideas and factors connected to each of the two SCM methodologies mentioned in the preceding sections, a Systematic Literature Review (SLR) was conducted. Research articles were collected from several reputed online databases such as Proquest, Scopus, EBSCO, Web of Sciences and research journals by searching through key words such as entrepreneurial ecosystem, startups, supply chain management, smart supply chain, sustainable supply chain, SMEs, small scale industries etc.

2.1 Startup Definition

According to Ripsas and Tröger (2014), a start-up is a young business that is under ten years old, has an innovative business plan or is implementing cutting-edge technologies, and/or exhibits a notable increase in either employee count or turnover. It has been observed that start-ups encounter numerous difficulties, and the majority of them fail soon after they go live. Key to the survival of start-ups is the ability to successfully attract, satisfy and maintain enough customers by implementing appropriate networks and partnerships through a robust supply chain system.

2.2 Smart Supply Chain Practices

This literature review explores the recent contributions and advancements in the area of smart supply chain management (SSCM) in startups. It focuses more specifically on startup practices related to SSCM, which have greater significance and ability to influence the development and promotion of entrepreneurial ecosystems. Several authors defined SCM from diverse perspectives. One such definition provided by Tatoglu et al., (2016) defines it as a compilation of multiple initiatives and actions initiated and practiced by a business organization to enhance the efficiency of its processes related to the flow of activities between supply and distribution of products and services.

Implementation and usage of emerging digital technologies such as Big Data Analytics (BDA), Artificial Intelligence (AI), Blockchain and Internet of Things (IoT) in the activities of supply chain management improves the operational efficiency and enables increase in the satisfaction of stakeholders leading to overall business sustainability (Maheshwari et al., 2020). During the past few years, systems of supply chain in SMEs and startups have witnessed a tremendous improvement with the integration of the above technologies in their business operations. Improvement in some of the supply chain metrics such as

availability of products throughout the stages of supply chain, their enhanced visibility for monitoring, optimization of costs related to the inventory of all types and achievement of the balance between supply and demand are some of the outcomes of integration of AI technologies and SC analytics in startup business operations (Ivanov, 2021; Nguyen et al., 2022). It also led to the shifting of startup operations towards sustainability enabling the development of a robust ecosystem of startups.

Application of digital technologies has enabled the ability of startup supply chain systems to identify and minimize the impact of risks and uncertainties by predicting them well in advance (Amedofu et al., 2019; Abdirad & Krishnan, 2021). Traditional and linear models of supply chains in startups are getting replaced with smart and technology-based supply chains (Felea & Albăstroiu, 2021). Supply chain managers in startups are able to arrive at fast and reliable solutions for complex decisions involved in supply chain operations through these technologies. Resilience, collaboration, cooperation and visibility of startup supply chains has significantly improved after the implementation of digital technologies. Technologies such as Internet of Things (IoT), Artificial Intelligence (AI), Big Data Analytics (BDA) and Blockchain have the ability to transform supply chains of startups to meet the requirements for improving the overall performance of startups and to develop an encouraging entrepreneurial ecosystem.

The predictive analytics system and IoT have improved the ability to forecast demand in a relatively more accurate manner resulting in optimization of inventory costs and efficiency in overall production levels in startups leading to reduction in production wastage. It also provided an opportunity for startups in redesigning their supply chains towards lean and agile practices. Digital technologies have also enhanced the ability of startups to take appropriate decisions related to supply chain resulting in speed and accuracy in their operations. Startups are also able to achieve optimization of costs related to data collection, information sharing and its acquisition (Witkowski, 2017). Planning of supply by synchronizing it with the production schedules reduced the risk levels related to inventory due to predictive analytics. Startups are able to manage their disruptions and uncertainties related to market fluctuations in a better manner due to these technologies. The impact on startups in such disruptive situations is minimal and the process to recover from such negative impact is quick. All these outcomes are leading the startups towards Smart Supply Chain Management (SmSCM) making them robust, resilient and sustainable. The emerging area of research is focusing on achieving sustainability related to environmental operations of startups by enhancing their ability to use resources optimally by effectively planning their supply chain and logistics operations (Lia et al., 2025).

Blockchain technology has enabled startups to achieve improved levels of mutual trust and accountability among their stakeholders related to supply chain activities (Witkowski, 2017). Startups can perform their transactions in a more secured manner throughout their supply chain operations globally due to blockchain technology (Bouti & El Khoukhi, 2023). This ability improves reduction of cyber threats and fraudulent operations in startup supply chain leading to increase in the mutual trust among members of this chain and enabling an entrepreneurial ecosystem (Gunduz et al., 2021; Tamym et al., 2021; Lelo & Israel, 2024).

Startups and SMEs can obtain huge advantages by analysing the large amounts of data generated by their supply chains through an accurate analysis in future, unlike the previous era. Mckinsey (2016) and Maheshwari et al., (2020) predict that the current revolution driven by data will bring unprecedented and sweeping changes in the manner in which the supply chains are managed in future in business organizations such as startups and SMEs. Supply chains in startups deal with huge data. Applications such as Big Data Analytics (BDA) have the ability to process huge volumes of data to provide realistic results for better and efficient decision-making leading to the sustainability of a startup. BDA also has the ability to develop an encouraging entrepreneurial ecosystem for startups. Thus, the current linear supply chains can be transformed into 'Smart Supply Chain' by making BDA an integral part of supply chain and business operations of startups and SMEs (Kot et al. 2020).

Supply chain management has been highly influenced by technology resulting in its contribution to huge data. Performing data analysis using statistical and machine learning techniques on various types of supply chain data (past, present) through predictive modelling providing useful information for improving the performance is generally termed as supply chain analytics (Gunasekaran et al., 2017). Supply chain analytics is also considered as a combination of digital technologies, IT resources, management of data and planning supply chain operations and analysis of data gathered through supply chain operations (Chae, Olson & Sheu, 2014). Digitization of supply chain systems in startups and SMEs would enable acquisition of new competencies such as optimization, tracking of products on a real time basis, development of visible supply chains, agile and lean manufacturing (Alshurideh et al., 2023).

2.3 Sustainable Supply Chain Practices

Carter and Rogers (2008) provided a comprehensive definition of Sustainable Supply Chain Management (SSCM). It focuses on the achievement of organization's goals in three aspects such as economic, social and environmental for achieving long-term sustainability. This definition is equally applicable for startups and SMEs too. Another SSCM definition provided by Seuring et al. (2008) linked sustainable supply chain activities with the management of product, information and cash flows of supply chain for achieving the goals related to triple bottom line i.e. people, plant and profit. Development of smart supply chains in startups also leads them towards green and environmentally friendly practices resulting in minimization of waste

(Frazzon et al., 2021). At the same time, the ability to achieve agility in supply chains through SSCM practices, enables startups to quickly react to vulnerable situations (Bhaveshkumar & Rane, 2020) and improve product quality (Elkazini et al., 2021). In Spite of several benefits of SSCM, research works in this area through a multi-dimensional approach are very limited, especially in startups and SMEs. Therefore, there is an urgent need to fill this research gap.

Linear supply chains in SMEs have resulted in depletion of natural resources due to excess production. (Shibin et al., 2020; Deineko et al., 2019). To minimize these negative outcomes of linear supply chain, supply chain practices such as mutual coordination, supply chain integration, sharing of information with supply chain members and entities are needed to be practiced by SMEs and startups to achieve sustainability (Papadopoulos et al 2020). Management of Stakeholders, Supplier Management for Sustainability, Governance of Supply Chain Value Chain, and Practices of Green Supply Chain are significant dimensions of Sustainable Supply Chain Practice (Varsei et al., 2014; Alam, 2022; Wijayaa, 2023), and they are also considered for the present study.

2.4 Entrepreneurial Ecosystem of Startups

In the present study, the influence of smart supply chain practices and sustainable supply chain practices on the development of entrepreneurial ecosystems is studied. Table-1 below presents the definitions of these variables.

Table 1
Variables of the study and their definitions

Variables	Definition	Reference
Entrepreneurial Ecosystem of Startups	Interconnected network of supply chain members, resources, and supply chain processes that support creation, growth, and sustainability of entrepreneurial ventures within a supply chain context.	Queiroz et al. (2020); Moreira and Barros (2022), Santos and Silva (2022)
Smart Supply Chain Practices	The application of smart and digital technologies for smooth and efficient management of supply chain processes and operations	Genovese, (2017); Alam (2022)
Sustainable Supply Chain Practices	Managing supply chain processes and operations to achieve three-dimensional sustainable development, i.e. economic, environmental, and social through the collaboration among supply chain members and all stakeholders.	Alshurideh et al., (2023); Bouti & El Khoukhi, (2023)

2.5 Overview of SME and Startup Sector in India

Small and Medium Enterprises (SMEs) in India are known as Micro, Small and Medium Enterprises (MSMEs). This sector in India produces a wide range of consumer as well as industrial products. These products range from beverages, food products, industrial tools and materials, textiles, jute products, electronic products and equipment, electronics items, medical and pharmaceutical products, and many other consumer and industrial products. Being a backbone of India's economic growth, the SME sector has been instrumental in generating employment and developing an entrepreneurial ecosystem.

The Indian SME sector also has a large number of service industries. This sector has been on a continuous growth from $45.55 billion in 2020-21 to $142.981 billion in 2024.25. This growth has been contributing to the growth of the Indian economy and global exports from India. Exporting enterprises of the MSME sector have increased from 52,849 units in 2020-21 to 173, 350 in 2024-25. During the years 2023-24, exports percentage was 45.73%, which increased to 45.79% by May 2024. Initiatives by the government and support from various entrepreneurial institutes and agencies have increased the contribution of the SME sector in the GDP of India demonstrating their adaptability and resilience. Many small enterprises have also scaled up from small to medium ones reflecting their robust growth and dynamism. The SME sector has played a significant role in developing innovation and enhancing competitiveness in the export sector. India boasts a separate ministry for SMEs, which oversees five members of this industry. These five members help SMEs in line with government policies and plans. For the service sector the government has started a unique program called Special Credit Linked Capital Subsidy Scheme (SCLCSS). This program aims to satisfy the digital technology demands of SMEs by means of government interventions. To boost their economic contribution, the Indian government also quadrupled the SMEs funding for 2022 (MSME statistics, Government of India). Thus, SMEs require help in the form of revamping their supply chains utilizing the two most crucial methods of making them "Sustainable" and "Smart" (Papadopoulos et al., 2020) if they are to reach outstanding performance in the future and develop the overall entrepreneurial ecosystem of startups regionally and globally (Lelo & Israel, 2024).

3. Hypothesis development

3.1 Sustainable Supply Chain Practices and Entrepreneurial Ecosystem of Startups

SMEs can increase productivity, lower costs, improve customer happiness, increase efficiency, and improve product availability by using supply chain (SC) techniques. Numerous SMEs have already used SCM to attain these beneficial results (Kot et al., 2020). A risk management plan, flexible organizational structure, and collaborative tactics would enhance SMEs'

performance by promoting their sustainability and contributing to the development of the entrepreneurial ecosystem. Additionally, it has been found that startups can scale up their enterprises by developing a robust ecosystem through the implementation of digital technologies, a stable network, and long-term financial resources (Stefenon & Gimenez, 2023). Instead of continuing to operate in an antiquated industry, SMEs should constantly search for new opportunities and prospects (Allaoui, 2019; Ahmad et al. 2020). The elements taken into consideration for a sustainable supply chain are information sharing, supplier partnership management, customer relationship management, and green supply chain practices.

H_1: *Sustainable Supply Chain Practice has a significant impact on developing the entrepreneurial ecosystem.*

3.2 Smart Supply Chain Practices and Entrepreneurial Ecosystem of Startups

Supply chains produce huge amounts of data and information due to their complexity and a wide network of members. The sources of data are multiple in supply chains. Most of the data originates from design of product, network of supply chain, stakeholders and members in supply chain, procurement, suppliers, manufacturing systems, strategic partners and logistics providers, selling points, customer feedback and many others (McKinsey, 2016). Prescriptive analytics will improve manufacturing, logistics, transportation, and warehousing processes, while the usage of predictive analytics will benefit risk assessment and management, forecasting, and procurement. Additionally, descriptive analytics can be used to generate reports from raw data. Supply chain managers get access to real-time and valuable data enabling them to make quick decisions related to innovative initiatives due to the application of supply chain analytics. It also enhances the ability of the firm in terms of analytics. Many areas of supply chain such as manufacturing, procurement, logistics, storage and distribution, reverse logistics are influenced by big data analytics and its application (Fernando et al., 2018).

Considering these trends, it is essential for startups and SMEs to identify new models of collaboration and innovative networks for achieving startup scalability and sustainability. This kind of development among startups contributes to the growth of a robust entrepreneurial ecosystem. Digital marketplaces and data cleanrooms will make data openness and seamless collaboration with strategic partners possible. As a result, SMEs and startups have a fantastic potential to use this data to improve their results in this digital age.

Big data analysis in the supply chain reduces the supply chain costs of SMEs significantly, boosts their performance, creates new value systems, and reduces risks (Maheshwari et al, 2020; Fatorachian & Kazemi, 2021). Studies related to identification of smart supply chain practices and their influence on SC related entrepreneurial ecosystems are limited (Al-Shbo et al., 2017; Amedofu et al., 2019). Sharing of information, Implementation of Digital Technologies, and Application of Supply Chain Analytics are considered as dimensions for Smart Supply Chain Practice (Gunasekaran et al., 2017; Kot et al. 2020).

Based on the above discussion, therefore, the Hypothesis-2 is formulated as below

H_2: *Smart Supply Chain Practice has a significant influence on developing the entrepreneurial ecosystem.*

3.3 Smart and Sustainable Supply Chain Practices and Entrepreneurial Ecosystem of Startups

Networks, human capital, and financial capital are the three main components of the entrepreneurial ecosystem that are essential for efficient supply chain management. In an entrepreneurial ecosystem, these factors play a critical role in determining the effectiveness, robustness, and scalability of supply chains for start-ups and small enterprises.

Financial Capital: One crucial factor influencing startups' capacity to establish and expand their supply chains is their access to financial resources. Entrepreneurs can invest in technology like automation and logistics optimization solutions that increase supply chain efficiency thanks to financial financing. Additionally, the availability of funds from government grants, angel investors, or venture capitalists' aids businesses in acquiring the raw materials they require and building connections with suppliers. Financial capital has a direct impact on strategy related decisions in supply chain management, enabling companies to increase delivery speed, lower prices, and diversify their suppliers (Moreira & Barros, 2022).

Human Capital: Knowledge and abilities of an entrepreneurial ecosystem influence the supply chain performance of startups. Access to professionals with experience in procurement, operations management, and logistics—all essential for creating effective supply chains—is made possible by a thriving business ecosystem. Entrepreneurs' expertise and comprehension of supply chain tactics are also included in the human capital dimension, as this affects their capacity to adjust to shifting market demands. Ecosystems with a solid foundation of trained human capital allow startups to innovate in supply chain operations, boosting their competitiveness, as proposed by Santos and Silva (2022).

Networks and Relationships: Developing networks and relationships is the main driver for effective supply chain flows and smooth processes of startups to develop an encouraging entrepreneurial ecosystem. Network Dimensions is the relationship among distributors, suppliers, entrepreneurs, and other important ecosystem participants. Developing a robust supply chain network would enable smooth flow of operations at various stages of the supply chain among different entities of the chain.

This enables mutual collaboration, resource sharing, and information exchange among supply chain partners leading to efficiency and process optimality. Effective networks provide startups with able partners who can provide with quick supply of raw material, information, better pricing, better negotiations and deals which develop ability to manage supply chain disruptions easily and quickly Martins and Pato (2021). This kind of network supported by able strategic supply chain partners develops a strong entrepreneurial ecosystem. Therefore, networks and relationships are an important aspect of the entrepreneurial ecosystem of startups.

3.4 Integration of Smart and Sustainable SC practices on EES of Startups

In a startup business environment, integration of smart supply chains with sustainable supply chains has gained significant interest and awareness. In order to overcome challenging competition among startups and SMEs, owners, founders and employees responsible for supply chains are forced to develop innovative practices. With the application and implementation of digital technologies such as Internet of Things (IoT), Big Data Analytics, Machine Learning and Artificial Intelligence (AI), startups are able to achieve better outcomes such as supply chain visibility, agility and transparency in their systems (Maheshwari et al., 2020). On the other hand, sustainable supply chain practices emphasize on focusing their activities towards contributing to society to fulfil their responsibility towards the environment. Startups can achieve the twin benefit of developing an entrepreneurial ecosystem and scaling up their enterprises by integrating these two supply chain practices. Digital technologies enable tracking of product movement throughout the supply chain by using IoT and AI. Whereas, block chain technology builds mutual trust and improves credibility, which are essential prerequisites for developing supply chain networks and relationships with all stakeholders of the chains. This in turn also supports improving transparency across the supply chain. These technologies also mitigate various forms of risks linked to asymmetry of information and scams, resulting in enhanced belief of stakeholders in the startup ecosystem. At the same time, increased awareness levels of customers and suppliers resulted in increased responsibility of startups towards the environment. Environmentally friendly supply chain activities minimize the risks related to compliance and regulatory requirements. These practices also lead startups to reduce waste, resulting in improved quality and reduced costs of supply chain operations leading them to achieve sustainability in the long run (Sarkis et al. 2020).

In order to survive in the dynamic market environment of startups, it is essential to integrate smart and sustainable supply chain practices, which focus on building a robust entrepreneurial ecosystem. Startups can achieve flexibility, resilience and sustainability through this integration. By analysing the huge amount of supply chain data by using data driven models, startups develop the ability to take timely and appropriate demand forecasting decisions leading to reduction in overproduction and excess stock. This results in reduction in the overall supply chain and operational costs of startups. By adopting smart and sustainable supply chain practices, startups can improve their brand image and increase their brand value and customer satisfaction. All these positive outcomes build confidence and trust among supply chain stakeholders and help in building a robust ecosystem. These two supply chain practices are also found to improve the ability to innovate the way founders manage their startup operations. Ability to introduce new products quickly is achieved through these practices by the startups. Activities of startups implementing digital technologies are more prone to produce novel items. They also develop harmonious relationships with all stakeholders of the supply chain leading to development of the entrepreneurial ecosystem of startups. Thus, integration of smart and sustainable chain practices has a greater influence on the entrepreneurial ecosystem and scalability of a startup through eco-friendly approaches (Sharma & Kumar, 2025). Management of Stakeholders, Supplier Management for Sustainability, Governance of Supply Chain Value Chain, and Practices of Green Supply Chain are the four variables taken into consideration for the sustainable supply chain practice in this study (Jorgensen & Knudsen 2006; Abbasi & Nilsson, 2012; Seuring & Muller, 2008; Beifert et al., 2013; Varsei et al., 2014). The dimensions for the smart supply chain practice are Sharing of Information, Implementation of Digital Technologies and Application of Supply Chain Analytics (Gunasekaran et al., 2017; Kot et al. 2020). Based on the above discussion, therefore, the Hypothesis-3 is formulated as below

H_3: *Sustainable and Smart Supply Chain Practices have a significant influence on the entrepreneurial ecosystem of startups.*

4. Research methodology and design

4.1 Research Framework

Analysis of issues in the literature review section reveal an urgent need for deeper investigation on the influence of smart and sustainable supply practices on the entrepreneurial ecosystem. The contributions that have already been made in this field are limited, and there is also a lack of clarity in the specific research that links smart and sustainable supply chain strategies with the entrepreneurial ecosystem (Amedofu et al., 2019). The purpose of the current study is to determine how SMEs apply smart supply chain and sustainable supply chain strategies, to develop an encouraging entrepreneurial ecosystem in startup projects. Through the two SCM practices, the primary goal of this research is to empirically identify the factors that contribute to the entrepreneurial ecosystems of startup projects through cost reduction and profit maximization and an opportunity for scaling up of startup projects. The dimensions taken into consideration for Sustainable Supply Chain Practice (Jorgensen & Knudsen 2006; Abbasi & Nilsson 2012; Seuring & Müller, 2008; Beifert et al., 2013; Varsei et al., 2014) in this study are Management of Stakeholders, Supplier Management for Sustainability, Governance of Supply Chain Value Chain, and

Practices of Green Supply Chain. On the other hand, Sharing of Information, Implementation of Digital Technologies and Application of Supply Chain Analytics are considered as components of smart supply chain practice (Gunasekaran et al., 2017; Kot et al., 2020). The three elements of the Entrepreneurial Ecosystem considered in this study are Financial Capital, Human Capital and Networks and Relationships (Moreira & Barros, 2022; Santos & Silva, 2022). The structure and relationships between the variables for the current investigation are shown in the Research Framework in Fig. 1.

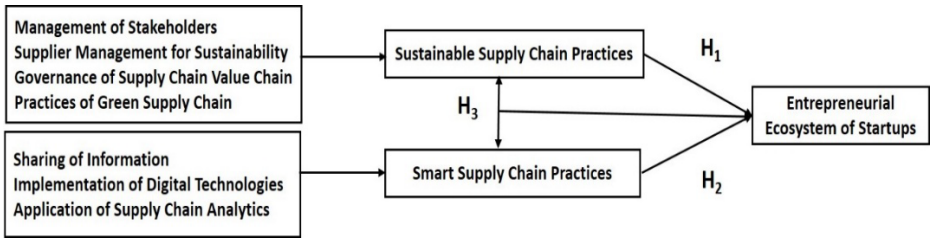

Fig. 1. Research Framework of the study

By employing a structured questionnaire as a research tool and survey instrument, the current study aimed to close the gap in the literature by gathering primary data experimentally from SMEs' and startup owners, strategic, and middle-level employees. The data was collected from SMEs and startup owners, senior level employees and supply chain heads by using the SMEs and Startups Membership directory of the State Government, Telangana State in India. This directory is the most reliable resource in the region, and it is an authentic one. Online survey method was used to electronically gather the responses for questionnaire

4.2 Population, Sample & Unit of Analysis

Criteria for selection of startups and SMEs is based on twin criteria. The first one is, based on a minimum number of at least hundred employees in the enterprise. While a minimum investment of $600,000 is the second criteria. This resulted in 320 startups and SMEs getting eligible and qualified for this study. Out of these, 240 enterprises were finalized for samples representing different sectors of startups and SMEs. A total of one thousand one-forty mails were addressed to owners, senior level supply chain managers and middle level managers of these SMEs in the selected sample. There were 220 responses in all. A research questionnaire with 40 items was used to gather the data. The results of this research are presented in this section.

5. Analysis

The aim of this study is to investigate how smart and sustainable supply chain practices influence and support the development of entrepreneurial ecosystems for startups and SMEs. Based on the systematic literature review as discussed in the preceding sections, four aspects of sustainable supply chain practice and three aspects of smart supply chain practices were taken into consideration. The responses from the chosen sample of startup SMEs were obtained using a standardized questionnaire. The study employed a descriptive, exploratory, causal, and analytical design. In order to validate the hypotheses, SPSS software was used for analysing the data for obtaining results related to demographic factors, reliability tests, descriptive statistics, correlation, and multiple regression.

5.1 Demographic Analysis

According to the research's demographic data pertaining to the respondents' personal characteristics, Table 2 displays the findings that, of the 220 respondents, 55% are men and 45% are women. The demographic data is presented in Table 2 below.

Table 2
Demographic Data

Item	Description	Frequency (N=220)	Percentage (%)
Gender	Male	120	54.4
	Female	100	45.5
Age	25-30	10	4.54
	31-40	25	11.36
	41-50	105	47.72
	>50	80	36.36
Designation	Startup Owner	75	34.10
	Sr. Supply Chain Manager	80	36.36
	Middle Level Supply Chain Manager	35	15.90
	Digital Technology Manager	30	13.60

N=220, Male=54.4%, Female=45.5%

5.2 Reliability, Descriptive Data and Correlation

To test the reliability, Cronbach's Alpha test was performed. Results of this test are displayed in Table 3 indicating a significant value of reliability for continuing for conducting the remaining tests. The descriptive tests on the responses yielded M=3.8, SD=84% for SSCP, and M=3.7, SD=73% for SmSCP. Result and outcome for Entrepreneurial Ecosystem variable indicate a satisfactory agreement while M=4.3, SD=76% for EE reveal that the majority of the questions are highly agreeable. Moreover, correlation test results indicate a significant and strong relationship between SSCP and EE, with a value of 0.738, which is significant.

Table 3
Validity, Descriptive & Correlation Summary

Variables	Cronbach's Alpha	Mean	Std Deviation	LS	AS	OW
Sustainable Supply Chain Practice (SSCP)	.89	3.8	0.84	1		
Smart Supply Chain Practice (SmSCP)	.88	3.7	0.73	0.843(**)	1	
Entrepreneurial Ecosystem (EE)	0.74	4.3	0.76	0.738(**)	0.666(**)	1

SSCP=Sustainable Supply Chain Practice (M=3.8, SD=84%),
SmSCP=Smart Supply Chain Practice (M=3.7, SD=73%),
*EE=Entrepreneurial Ecosystem (M=4.3, SD=76%) *P<0.001, **P<0.05*

5.3 Multiple Regression

Table 4 below displays the findings of the multiple regression analysis done on the replies for the sustainable supply chain approach.

Table 4
ANOVA analysis of Sustainable Supply Chain Practice (SSCP) Variables

	R	R^2	F	Sig	Df	Dimensions	β	t-value	Sig*
Entrepreneurial Ecosyst	0.724	0.586	54.0	.000		Management of Stakeholders	.222	3.11	.000
					4	Supplier Management for Sustainability	.520	7.74	.000
					216	Governance of Supply Chain Value Chain	.019	1.81	.005
					220	Practices of Green Supply Chain	.162	3.24	.004

**Level of Significance (α<0.05)* ***Critical t-value (df/p) = 1.66*

Table 5 below depicts the outcome of analysis of responses related to multiple regression for smart supply chain practices.

Table 5
ANOVA analysis of Smart Supply Chain Practice (SmSCP) Variables

	R	R^2	F	Sig	Df	Dimensions	β	t-value	Sig*
Entrepreneurial Ecosystem	0.686	0.454	58.2	.000	3	Sharing of Information	.248	3.24	.000
					217	Implementation of Digital Technologies	.372	3.18	.001
					220	Application of Supply Chain Analytics	.168	2.94	.006

**Level of Significance (α<0.05)* ***Critical t-value (df/p) = 1.66*

5.4 Hypothesis Testing

Table 6
Hypothesis testing using regression coefficients

Hypothesis	Relationships	β	R^2	Adjusted R^2	p-value	Status of Hypothesis
H_1	SSCP → EE	0.728	0.532	0.528	0.000	Supported
H_2	SmSCP → EE	0.674	0.438	0.422	0.000	Supported
H_3	SSCP→ SmSCP → EE	0.722	0.542	0.518	0.000	Supported

**P<0.001, **P<0.05*

6. Results and Discussion

The findings of this study show very interesting results. They unequivocally show that the two most crucial supply chain practices—smart supply chains and sustainable supply chains—have a major influence on the entrepreneurial ecosystem of startups. These two important practices related to supply chain enable the development of an encouraging entrepreneurial ecosystem for startups.

According to the results in Table 4 related to multiple regression analysis of sustainable supply chain practice and entrepreneurial ecosystem, the practices related to management of suppliers for sustainability significantly impact the entrepreneurial ecosystem of SMEs (β =.520 and t = 7.74). In order to achieve sustainability and develop an entrepreneurial ecosystem, it is very important to manage their supplier network with startups. This network should implement practices related to sustainability for suppliers to achieve sustainability in their respective supply chains as they procure raw material from suppliers. Supplier management by startups involve just-in-time purchasing, management of supplier's raw materials,

certification of raw material for sustainable practices, audit of suppliers, training and developing suppliers for best practices in SMEs (Alam, 2022). The second component of a sustainable supply chain practice that affects the entrepreneurial ecosystem is management of important stakeholders with β =.222 and t = 3.11. Likewise, governance of supply chain value chain and practices of green supply chain have an impact on organizational performance in SMEs (Ramakrishna, 2016; Ivanov 2021).

According to Table 5's multiple regression results, implementation of digital technologies of affordable scale has the greatest impact on developing an encouraging entrepreneurial ecosystem (β=.372 and t=3.18). The other variables such as sharing of information (β=.248 and t=3.24) and application of supply chain analytics (β=.168 and t=2.94) have significant impact on the entrepreneurial ecosystem of startups. All three hypotheses are supported by significant R2 and p values, according to the results in Table 6. Therefore, it is clearly evident that smart and sustainable supply chain practices significantly influence the development of the entrepreneurial ecosystem of startups.

7. Conclusions

The two most crucial SCM practices considered in this study, the sustainable and smart supply chain practices have a major influence on the development of the entrepreneurial ecosystem of startups. This empirical investigation of select startups in India provides a major insight in the area of supply chain practices. Startups have the ability to implement these two practices and contribute to the entrepreneurial ecosystem. It is also evident that supply chain plays a significant role in this ecosystem. An entrepreneurial ecosystem supported with a robust environment enables startups to advantage for scaling up their businesses and achieve sustainability. Implementation of practices related to smart supply chains will provide startups an ability to bring sweeping changes in their existing traditional supply chains to make them smart and lean. By properly implementing the practices related to smart and sustainable supply chains, startups can focus on achieving sustainability. Practices outlined in the above sections play a key role in driving the startup supply chains ready for future business environments. As it is evident from the discussions in the previous sections, SMEs and startups in India and the world are more fragile and vulnerable towards supply chain disruptions and unforeseen business situations. Therefore, implementation of findings and recommendations of this study would equip them with abilities to manage such disruptions with minimum impact and also recover quickly.

8. Recommendations

The results of this study provide some interesting recommendations to the founders, owners and senior levels employees of supply chain management in startups. It is recommended that these people should play a vital role by analysing their existing supply chains and redesign them towards implementing smart and sustainable supply chain practices. This requires them to focus on identifying affordable digital supply chain technologies for developing their supply chains into robust and smart supply chains. At the same time, it is also essential to concentrate on identifying supply chain practices, which enable sustainability and provide scalability to the existing operations of startups. Thus, by this redesign, startups would be able to contribute to their ecosystem and build an entrepreneurial ecosystem. In this process, it is also important to focus on practices adopted by suppliers of startups as these suppliers contribute to the long-term sustainability of startups. Management of stakeholders is also another practice recommended through this study. Stakeholders also play an important role and contribute to the overall development of startups. Startups can achieve sustainability by managing their suppliers and other important stakeholders effectively. While focusing on developing practices to transform their existing production and distribution systems to be green, startups at the same time must concentrate on developing a sustainable value chain and green supply chain. Startups can transform their linear supply chains to smart supply chains by taking the leverage through the implementation of digital technologies and supply chain analytics (Gunasekaran et al., 2017).

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